

CLAIMS

1. A method for removing both (i) ionizable and/or ionized carbon compounds and
(ii) non-ionized and/or non-ionizable carbon compounds from water comprising the steps of
(a) processing a first stream of the water with a first removal apparatus for removing
5 from the water ionized and/or ionizable carbon compounds, wherein at least some of such
ionized and/or ionizable carbon compounds are susceptible to conversion to non-ionized and/or
non-ionizable carbon compounds by step (b) below, to produce a first product stream containing
a smaller concentration of ionized and/or ionizable carbon compounds than the first stream;
(b) contacting the first product stream with an agent for converting non-ionized and/or
10 non-ionizable carbon compounds into ionized and/or ionizable carbon compounds at a time and
a temperature sufficient to form a second product stream containing a smaller concentration of
non-ionized and/or non-ionizable carbon compounds and a larger concentration of ionized and/or
ionizable carbon compounds than the first product stream;
(c) processing the second product stream with a second removal apparatus for removing
15 ionized and/or ionizable carbon compounds from the water to form a third product stream
containing a smaller concentration of ionized and/or ionizable carbon compounds and non-
ionized and/or non-ionizable carbon compounds than the first stream; and
(d) recovering the third product stream from step (e).

2. A method according to claim 1 wherein the first removal apparatus comprises the
second removal apparatus.

3. A method according to claim 1 wherein at least one of the first removal apparatus
and the second removal apparatus is selected from the group consisting of a reverse osmosis
25 apparatus, nanofiltration apparatus, ion exchange apparatus, electrically regenerated ion
exchange apparatus, chemically regenerated ion exchange apparatus, electrodeionization
apparatus, electrodialysis apparatus, filled cell electrodialysis apparatus, electrodiuresis
apparatus, activated carbon apparatus and other sorbent apparatus.

4. A method according to claim 1 wherein the agent is an oxidizing agent selected
from the group consisting of a oxygen, ozone, singlet oxygen, hydrogen peroxide, chemical
oxidizing agent, electrolytic oxidizing agent, electrochemical oxidizing agent, catalytic oxidizing
agent, thermal oxidizing agent, and radiation.

5. A method according to claim 4 wherein the oxidizing agent is radiation characterized by wavelengths of about 184.9 nm.
6. A method according to claim 1 wherein the agent comprises ultraviolet radiation.
7. A method according to claim 6 wherein the agent further comprises hydrogen peroxide.
8. A method according to claim 6 wherein the agent further comprises ozone.
9. A method according to claim 6 wherein the agent further comprises a catalyst.
10. A method according to claim 9 wherein the catalyst is titanium oxide.
11. A method according to claim 1 wherein the agent comprises ozone and hydrogen peroxide.

12. An apparatus for removing both (i) ionizable and/or ionized carbon compounds and (ii) non-ionized and/or non-ionizable carbon compounds from water comprising

(a) a first removal means for removing from the water ionized and/or ionizable carbon compounds, wherein at least some of such ionized and/or ionizable carbon compounds are susceptible to conversion to non-ionized and/or non-ionizable carbon compounds by conversion means(b) below, to produce a first product stream containing a smaller concentration of ionized and/or ionizable carbon compounds than the first stream;

(b) a conversion means for converting non-ionized and/or non-ionizable carbon compounds into ionized and/or ionizable carbon compounds at a time and a temperature sufficient to form a second product stream containing a smaller concentration of non-ionized and/or non-ionizable carbon compounds and a larger concentration of ionized and/or ionizable carbon compounds than the first product stream;

(c) a second removal means for removing ionized and/or ionizable carbon compounds from the water to form a third product stream containing a smaller concentration of ionized and/or ionizable carbon compounds and non-ionized and/or non-ionizable carbon compounds than the first stream; and

(d) a recovery means for recovering the third product stream.

13. An apparatus according to claim 12 wherein the first removal means comprises the second removal means.

14. An apparatus according to claim 12 wherein the first removal device is selected from the group consisting of reverse osmosis apparatus, nanofiltration apparatus, ion exchange apparatus, electrically regenerated ion exchange apparatus, chemically regenerated ion exchange apparatus, electrodeionization apparatus, electrodialysis apparatus, filled cell electrodialysis apparatus, electrodiuresis apparatus, activated carbon apparatus and other sorbent apparatus.

15. An apparatus according to claim 12 wherein the conversion means comprises contact means for contacting the first product stream with an agent.

16. An apparatus according to claim 15 wherein the agent is an oxidizing agent selected from the group consisting of a oxygen, ozone, singlet oxygen, hydrogen peroxide, chemical oxidizing agent, electrolytic oxidizing agent, electrochemical oxidizing agent, catalytic oxidizing agent, thermal oxidizing agent, and radiation..

17. An apparatus according to claim 16 wherein the oxidizing agent is radiation characterized by wavelengths of about 184.9 nm.

18. An apparatus according to claim 15 wherein the agent comprises ultraviolet radiation.

19. An apparatus according to claim 18 wherein the agent further comprises hydrogen peroxide.

20. An apparatus according to claim 18 wherein the agent further comprises ozone.

21. An apparatus according to claim 18 wherein the agent further comprises a catalyst.

22. An apparatus according to claim 21 wherein the catalyst is titanium oxide.

23. An apparatus according to claim 15 wherein the agent comprises ozone and hydrogen peroxide.